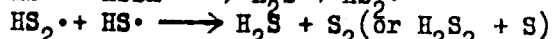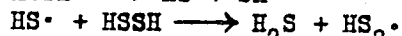SOV/79-28-6-46/63

Reactions of Free Radicals in Solution. XIV. The Formation of Free Radicals in the Decomposition of Hydrogendisulfide and Their Reactions With α- and β-Olefines

etc.; in this connection it must be noted that in the vulcanization of rubber no formation of hydrogen sulfide was observed. Apparently the decomposition of H_2S_2 takes place according to the chain mechanism through the stage of the ·SH- and ·S_2H radicals, as is the case with hydrogen peroxide:

$$HSSH \longrightarrow HS· + ·SH$$
$$HS· + HSSH \longrightarrow H_2S + HS_2·$$
$$HS_2· + HS· \longrightarrow H_2S + S_2 (\text{or } H_2S_2 + S)$$
$$HS· + HS· \longrightarrow H_2S + S$$

The radical character of this reaction was proved by the decomposition of the hydrogen disulfide in the presence of an acceptor for free radicals, the nitric oxide. In the case of a heating in ethylbenzene solution at $7o°$ and a simultaneous passage of gaseous NO no formation of H_2S_2 takes place. Earlier it was shown that hydrogen sulfide does not enter reaction with NO on the same conditions. The decomposition of hydrogen disulfide in various olefines, containing external and internal double bonds, was investigated. The relative reactivity of the olefines was determined ac-

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SOV/79-28-6-46/63

Reactions of Free Radicals in Solution. XIV. The Formation of Free Radicals in the Decomposition of Hydrogendisulfide and Their Reactions With α- and β-Olefines

cording to the composition of the final products and according to the amount of the forming hydrogen sulfide (Tables 1 and 2). In the decomposition of hydrogen disulfide in olefines having a double vinyl bond (α-pentene, styrene, isoprene) the formation of H_2S is completely obstructed, which is only partly the case with β-pentene, cyclohexene. The conversion products of H_2S_2 with α- and β-pentenes, and cyclohexenes were separated and characterized, and their mechanism of formation were checked. Concluding it may be stated that the reactivity of the α-olefines with respect to the given radicals is by far higher than that of the β-olefines. There are 1 figure, 2 tables, and 14 references, 1o of which are Soviet.

ASSOCIATION: Institut vysokomolekulyarnykh soyedineniy Akademii nauk SSSR i Vsesoyuznyy nauchno-issledovatel'skiy institut sinteticheskogo kauchuka
(Institute of High Molecular Compounds,AS USSR and All-Union Scientific Research Institute of Synthetic Rubber)

Card 3/4

AUTHORS: Tinyakova, Ye. I., Khrennikova, Ye. K., SOV/79-28-12-24/41
Dolgoplosk, B. A.

TITLE: On the Effective Mechanism of the Accelerators in the Process
of Sulfur Vulcanization (O mekhanizme deystviya uskoriteley
protsessu sernoy vulkanizatsii)

PERIODICAL: Zhurnal obshchey khimii, 1958, Vol 28, Nr 12, pp 3269-3274
(USSR)

ABSTRACT: To explain the effective mechanism of the accelerators in the
vulcanization it was necessary to investigate the composition
of the products formed in the reaction with sulfur in various
solvents, and to compare them to the composition of the de-
composition products of H_2S_2 in the same solvents. For this
reason, the reaction of monoethanol amine, ethylene diamine
and fructose with sulfur in the pentenes-1 and -2, in cyclo-
hexane, isoprene, α-methyl styrene, styrene, ethyl benzene,
and in rubber solution at 130-160° was investigated. This pro-
cess was characterized according to the formation of H_2S. In
the case of the reaction of monoethanol amine with sulfur in
the pentenes-1 and -2 all main reaction products were separated

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On the Effective Mechanism of the Accelerators   SOV/79-28-12-24/41
in the Process of Sulfur Vulcanization

and characterized. In table 1 the data are mentioned which characterize the formation of H_2S in the reaction of sulfur with the vulcanization accelerators, as well as in the decomposition of H_2S_2 in various solvents. In table 2 the experimental results of the composition of the reaction products of sulfur with monoethanol amine in the solution of pentenes-1 and -2 are mentioned together with the results of the experiments on the decomposition of H_2S_2, which are given for the purpose of comparison. It was shown that the reaction of sulfur with various reducing agents which occur in the sulfur vulcanization as accelerators takes place by way of an intermediate stage of H_2S_2 under the formation of $S^{\cdot}$ and $S_2^{\cdot}$. Based on the investigation of the composition of the products formed in the reaction of sulfur with the vulcanization accelerators and in the decomposition of H_2S_2 in α - and β -olefins, a more detailed information on the mechanism of the occurring sulfur formations in the vulcanization process is obtained, and the part is

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On the Effective Mechanism of the Accelerators   SOV/79-28-12-24/41
in the Process of Sulfur Vulcanization

detected which is played by the accelerators therein. It was
shown that the outer double bonds are much more reactive in
the reaction with the radicals HS· and HS_2· than the inner
ones. At temperatures up to 130° the radicals HS· do not
separate hydrogen from the aliphatic hydrocarbon solvents.
There are 2 tables and 13 references, 8 of which are Soviet.

ASSOCIATION: Institut vysokomolekulyarnykh soyedineniy Akademii nauk SSSR
(Institute of High-Molecular Compounds, Academy of Sciences,
USSR)

SUBMITTED: November 10, 1957

Card 3/3

89024

S/020/60/135/004/021/037
B016/B062

11. 2211

AUTHORS: Dolgoplosk, B. A., Corresponding Member AN USSR,
              Kropacheva, Ye. N., Khrennikova, Ye. K., Kuznetsova, Ye. I.,
              and Golodova, K. G.

TITLE: Polymerization of Dienes Under the Influence of Homogeneous
              Catalytic Systems Containing Salts of Cobalt and Nickel

TEXT: The authors report on the considerable efficacy of homogeneous
catalysts in the production of cis-polybutadiene from butadiene in benzene
solution. The catalysts were hydrocarbon-soluble systems of cobalt chloride
(concentration 0.005 - 0.01 percentage by weight, as referred to the
monomer) in complex with pyridine or ethanol in combination with alkyl-,
dialkyl-, and trialkyl aluminum chlorides. Polymerization takes place al-
ready at $0^{\circ}C$ and ?.005 % cobalt chloride, the polymer structure being in-
dependent of temperature. The polymer yield rises with increasing concen-
tration of the cobalt chloride, while the molecular weight of the polymer
decreases. The polymerization rate is highest at a concentration of 0.01 %,

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Polymerization of Dienes Under the Influence   S/020/60/135/004/021/037
of Homogeneous Catalytic Systems Containing   BC16/B062
Salts of Cobalt and Nickel

whereas the molecular weight in the entire concentration range studied de-
creases simultaneously with the acceleration of polymerization. The tem-
perature rise from $5°$ to $30°C$ also reduces the molecular weight to
1/2 - 1/3. The role of the displacement reactions becomes much more con-
siderable in the presence of lower olefins. For instance, approximatively
1 % of β-butene (referred to the monomer) considerably decelerates the
polymerization and reduces the molecular weight of the polymer from
150 000 to 90 000. On the strength of data on the microstructure of poly-
butadiene the authors found, depending on the catalyst system (Table 1,
polymerization of divinyl), that the highest percentage of 1,4-members was
obtained with diisobutyl aluminum chloride systems (97 %) and diethyl
aluminum chloride systems. Triisobutyl aluminum considerably increases the
number of 1,2-members (up to 70 %). Cobalt salts of stearic acid lead to
an only inconsiderably deviating chain structure in the range of concentra-
tions ensuring a homogeneous system. Polybutadiene produced in the pre-
sence of nickel stearate has a chain structure similar to that of cobalt
stearate, but a lower molecular weight. If iron benzoate and stearate is
used, the polymerization is considerably slower than with cobalt- and

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Polymerization of Dienes Under the Influence   S/020/60/135/004/021/037
of Homogeneous Catalytic Systems Containing   B016/B062
Salts of Cobalt and Nickel

nickel salts. The cobalt systems are also effective in the polymerization
of other diene-hydrocarbons, especially of isoprene. There are 2 figures,
1 table, and 7 references: 5 Soviet, 1 US, and 1 German.

ASSOCIATION: Vsesoyuznyy nauchno-issledovatel'skiy institut sintetiches-
                kogo kauchuka im. S. V. Lebedeva (All-Union Scientific
                Research Institute of Synthetic Rubber imeni S. V. Lebedev)

SUBMITTED: August 22, 1960

Card 3/3

KHRENNIKOVA, YE. K.

S/020/62/144/004/015/024
B101/B138

AUTHORS: Grechanovskiy, V. A., Dolgoplosk, B. A., Corresponding Member
AS USSR, Kropacheva, Ye. N., Poddubnyy, I. Ya., Sterenzat,
D. Ye., and Khrennikova, Ye. K.

TITLE: Distribution of molecular weight in stereographically regular
polybutadiene polymerized under the influence of "cobalt"
systems

PERIODICAL: Akademiya nauk SSSR. Doklady, v. 144, no. 4, 1962, 792 - 794

TEXT: Changes in the molecular weight of polybutadiene and in its distri-
bution M_0 were studied in relation to the monomer concentration and degree
of polymerization. The polymerization was performed in a 10% solution of
the butadiene in benzene, in the presence of a complex catalyst composed of
$CoCl_2 \cdot C_2H_5OH$ and $Al(iso-C_4H_9)_2Cl$, the concentration of the $CoCl_2$ being
0.01 % and that of the dibutyl-aluminum chloride 2% as referred to the
monomer. The M_0 was found using an ultra-centrifuge ($\sim$180,000 g), hexane
and heptane in equal proportions being thermodynamically almost ideal as

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Distribution of molecular weights...

a solvent, and the calculation being done according to S. Ya. Frenkel' (ZhTF, 24, no. 12, 2167 (1954)). Results: (1) With 20% conversion the maximum M_0 came at about 245,000. This enabled the number average molecular weight $\overline{M}_n$ to be calculated as 270,000 and the weight average molecular weight $\overline{M}_w$ as 320,000. (2) With 97% conversion M_0 was about 90,000, $\overline{M}_n$ was 136,000 and $\overline{M}_w$ was 265,000. Similar results were obtained with the catalyst $CoBr_2 \cdot C_2H_5OH - Al(iso-C_4H_9)_2Cl$. (3) Stepwise addition of the monomer, each successive portion thereof being added only after the preceding portion was completely polymerized, gave $M_0 = 55,000$, $\overline{M}_n = 68,000$ and $\overline{M}_w = 180,000$ for all of the successively polymerized portions. Conclusions: (a) The catalyst is fully regenerated and remains active for a long time (>100 hr); (b) the reduced M_0, $\overline{M}_n$ and $\overline{M}_w$ in case (2) is due to reduction in the monomer concentration when polymerization lasts longer; (c) in case (3) two opposite tendencies compensate one another; namely the tendency to higher M_0 through the catalyst becoming

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Distribution of molecular weights...

diluted by added portions of monomer and the tendency to lower M_0 as a result of diminishing butadiene concentration; hence all portions show the same values of M_0, $\bar{M}_n$ and $\bar{M}_w$. There are 4 figures.

ASSOCIATION: Vsesoyuznyy nauchno-issledovatel'skiy institut sintetichenkogo kauchuka im. S. V. Lebedeva (All-Union Scientific Research Institute of Synthetic Rubber imeni S. V. Lebedev)

SUBMITTED: March 13, 1962

Card 3/3

GRECHANOVSKIY, V.A.; DOLGOPLOSK, B.A.; KROPACHEVA, Ye.N.; PODDUBNYY, I.Ya.;
STERENZAT, D.Ye.; KHRENNIKOVA, Ye.K.

Molecular weight distribution of steroregular polybutadiene
obtained by polymerisation in the presence of "cobalt" systems.
Dokl.AN SSSR 144 no.4:792-794 Je '62.   (MIRA 15:5)

1. Vsesoyuznyy nauchno-issledovatel'skiy institut sinteticheskogo
kauchuka im. S.V.Lebedeva. 2. Chlen-korrespondent AN SSSR (for
Dolgoplosk).
        (Butadiene)   (Polymerization)   (Cobalt compounds)

KHRENOV, A. D.

ALEKIN, L.Ye.; BALABIN, V.V.; GLADILIN, A.N.; DUBININ, N.P.; KOSYAKOV, K.P.
POPOV, L.A.; KHRENOV, A.D.

[The organization of standard workshops for students of the "metal
technology" departments of technical colleges] Metodika organisatsii
tipovykh uchebnykh masterskikh kafedry "Tekhnologiia metallov" vtu-
zov. Moskva, Sovetskaia nauka, 1953. 243 p.   (MLRA 7:7)

1. Moscow. Moskovskoye vyssheye tekhnicheskoye uchilishche. Kafedra
"Tekhnologiya metallov".
        (Metalwork--Study and teaching)

ALEKIN, Lev Yemel'yanovich; GLADILIN, Anatoliy Nikolayevich; KRASAVIN,
Vasiliy Stepanovich; LUNEV, Fedor Andreyevich; MAKAROVA, Vera
Ivanovna; RASTORGUYEV, Ivan Sergeyevich; KHRENOV, Aleksey Dmi-
triyevich; TSEYTLIN, V.Z., kandidat tekhnicheskikh nauk, redak-
tor; RZHAVINSKIY,V.V., inzhener; redaktor; SHUR, D.S., redaktor;
EGGERT, A.P., tekhnicheskiy redaktor.

[General technology of metals] Obshchaia tekhnologiia metallov.
Moskva, Vse.uchebno-pedagog.izd-vo Trudrezervizdat, 1956. 327 p.
                    (Metals)

25(1)   PHASE I BOOK EXPLOITATION   SOV/1346

Khrenov, Aleksey Dmitriyevich

Spravochnik molodogo kuznetsa-shtampovshchika (Manual for the Young Forge and
    Press Operator) Moscow, Trudrezervizdat, 1958. 256 p. 35,000 copies printed.

Ed.: Litvak, D.S.; Tech. Ed.: Rakov, S.I.

PURPOSE: The book is intended for workers, foremen, technicians and designers en-
    gaged in forging and sheet forming in industrial plants.

COVERAGE: This book deals with various aspects of forging on the production level.
    Metals used in forging are briefly reviewed together with their physical proper-
    ties, method of testing, and applications. The author goes on to explain the
    principles of forging, the temperature regime during forging operations, and the
    heating arrangements used. A number of chapters deal with the design of forg-
    ing, the range of permissible tolerances and machining allowances. Problems of
    die design and the equipment used in forging, such as forge hammers of various
    designs and presses with hydraulic and mechanical drives receive a thorough treat-
    ment. Finally, some special methods of forging, press-forming, and sheet metal
    forming are described. The text contains a number of illustrations, formulas,
    and graphs. There are 28 Soviet references.
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Manual for the Young (Cont.)   SOV/1346

AVAILABLE: Library of Congress

                                    GO/sfm
                                    3-25-59

Card 6/6

ALEKIN, L.Ye., dotsent, kand.tekhn.nauk; GLADILIN, A.N., dotsent, kand.
tekhn.nauk; KRASAVIN, V.S., starshiy prepodavatel'; LIPERENKO,
N.N., dotsent, kand.tekhn.nauk; MAKAROVA, V.I., dotsent, kand.
tekhn.nauk; KHRENOV, A.D., starshiy prepodavatel'. Prinimali
uchastiye: LUNEV, V.A. [deceased]; RASTORGUYEV, I.S. [deceased];
BILINSKIY, M.Ya., red.; DORODNOVA, L.A., tekhn.red.

[General technology of metals] Obshchaia tekhnologiia metallov.
Izd.3., perer. i dop. Moskva, Vses.uchebno-pedagog.izd-vo Prof-
tekhizdat, 1960. 381 p.   (MIRA 13:12)
        (Metals)   (Metalwork)

ANDREYEV, V.P., polkovnik; BORISOV, D.S., polkovnik; SHOR, D.I., dotsent, kand.tekhn.nauk, inzh.-polkovnik zapasa; ZHELEZNYKH, V.I., dotsent, kand.tekhn.nauk, general-leytenant inzhenernykh voysk, otv.red.; KHRENOV, A.F., general-polkovnik inzhenernykh voysk, red.; NAZAROV, K.S., dotsent, general-polkovnik inzhenernykh voysk v otstavke, red.; KOVALENKO, L.P., red.; STREL'NIKOVA, M.A., tekhn.red.

[Military engineering and the Corps of Engineers in the Russian Army; a collection of articles] Voenno-inzhenernoe iskusstvo i inzhenernye voiska russkoi armii; sbornik statei. Moskva, Voen. izd-vo M-va obor. SSSR, 1958. 209 p.   (MIRA 12:6)
                    (Military engineering)

ANDREYEV, V.P., polkovnik; BORISOV, D.S., polkovnik; ZHELEZNYKH, V.I.,
    dotsent, kand.tekhn.nauk, general-leytenant inzhenernykh voysk
    v otstavke, otv.red.; NAZAROV, K.S., dotsent, general-polkovnik
    inzhenernykh voysk v otstavke, red.; KHRENOV, A.F., general-
    polkovnik inzhenernykh voysk, red.; SHOR, D.I., dotsent, kand.
    tekhn.nauk, inzhener-polkovnik zapasa, red.; ROSSAL, N.A.,
    polkovnik, red.; KHLYSTALOV, S.I., polkovnik, red.; SOLOMONIK,
    R.L., tekhn.red.

[The Soviet military engineers, 1918-1940; collection of articles]
Sovetskie inzhenernye voiska v 1918-1940 gg.; sbornik statei.
Moskva, Voen.izd-vo M-va obor.SSSR, 1959. 141 p.   (MIRA 13:4)
                    (Military engineering)

L 34203-65   EWT(m)/EPF(c)/EPR/EWP(j)/T   Pc-4/Pr-4/Ps-4

ACCESSION NR: AP5007217   S/0286/65/000/003/0113/0113

AUTHOR: Peshekhonov, A. A.; Baybakov, K. P.; Makharinskiy, Ye. G.; Smyslov, V. L.;
Khrenov, A. M.; Smirnov, A. A.; Mironov, A. K.; Kudryavtsev, V. V.

TITLE: A method for manufacturing pipes and similar articles from laminated
plastics. Class 80, No. 168169

SOURCE: Byulleten' izobreteniy i tovarnykh znakov, no. 3, 1965, 113

TOPIC TAGS: thermosetting plastic, glass fabric, laminated plastic, plastic tech-
nology

ABSTRACT: This Author's Certificate introduces a method for manufacturing pipes
and similar articles from laminated plastics. The process consists of winding some
such material as resin-saturated glass fabric on a mandrel and heating (e.g. with
hot rollers). Liquid thermosetting resins which do not contain volatile solvents
are fed continuously to the mandrel during the winding and heating process. This
is done to make the completed article airtight.

ASSOCIATION: none

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SOV/177-58-7-5/28

17(8)

AUTHOR: Khrenov, A.P., Colonel of the Medical Corps

TITLE: Problems of the Medical Supply of Troops and Medical Field Institutions

PERIODICAL: Voyenno-meditsinskiy zhurnal, 1958, Nr 7, pp 26-29 (USSR)

ABSTRACT: The article deals with the problem of supplying troops with medical equipment. Modern warfare makes it necessary to solve this problem in a way quite different from that of WW II. The author elucidates 3 basic principles for discussion: a) the calculation of the requirements for medical equipment; b) the storage of medical equipment and the work of the pharmacies; c) fundamental tasks of the organs of the medical supply.

Card 1/1

KLOCHKOV, A.P., inzh., red.; KHRENOV, A.S., inzh., red.; MUNITS, A.P., red.izd-va; PRUSAKOVA, T.A., tekhn.red.

[Production standards for planning and research work paid for according to a piece-rate system] Normy vyrabotki na proektnye i izyskatel'skie raboty, oplachivaemye sdel'no. Moskva, Gos. izd-vo lit-ry po stroit., arkhit. i stroit.materialam. Pt.13 [Electric power and blower stations; furnaces] Elektricheskie i vozdukhoduvnye stantsii, kotel'nye. Section 3. [Hydro-electric power stations] Gidroelektrostantsii. 1958. 67 p.
(MIRA 12:7)

1. Russia (1923- U.S.S.R.) Ministerstvo elektrostantsiy. (Heat engineering) (Hydroelectric power stations)

SOV/56-34-5-4/61

AUTHORS: Abrosimov, A. T., Goryunov, N. N., Dmitriyev, V. A.,
              Solov'yeva, V. I., Khrenov, B. A., Khristiansen, G. B.

TITLE: The Structure of the Extensive Atmospheric Showers at Sea
              Level (Struktura shirokikh atmosfernykh livney na urovne
              morya)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958,
              Vol. 34, Nr 5, pp. 1077-1089 (USSR)

ABSTRACT: This paper investigates the lateral distribution of electrons,
              nuclear active and nuclear passive particles in extensive
              air showers containing from $4 \cdot 10^4$ to $4 \cdot 10^5$ particles at sea
              level by means of correlated hodoscopes. These measurements
              were carried out from April to May of 1954 in Moscow. The
              authors used the hodoscopes K-5 of L. N. Korablev. At first
              the measuring device is discussed, which gave a sufficiently
              exact distribution of the density of the charged particles
              near the axis of any registered shower. By means of these
              data it is possible to determine the individual properties
              of the shower, - the position of its axis and the number of
Card 1/3   the particles. As zero approximation of the position of the

The Structure of the Extensive Atmospheric Showers at Sea Level

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axis the center of the region of maximal density of particle
flux was taken. Also the determination of the second approxi-
mation is discussed in a few words, but the use of this second
approximation is practically not necessary. The second char-
acteristic of the shower - the total number N of the particles,
was found after determining the position of the axis.
Therefore the total number of the particles in the central re-
gion of the shower was used as a standard of the total number
of particles. The experimental data concerning the spacial
distribution of all charged particles may be approximated
by the function $kNr^{-1}e^{-r}/R$ with R = (60 6) m for the region
$2 \ll r \leqslant R(n-1)$ and by the exponential function $k_1 Nr^{-n}$ for
the region $r \gg R(n-1)$ with n=2,6 $\pm$ 0,4. The coefficients K
and k_1 are found from the normalizing conditions of the func-
tion of spacial distribution. The hodoscopic device was also
used for the determination of the number of the registered
extensive showers with a fixed number N of particles. The
energy flux of the shower is concentrated in a small region
possessing a small radius of the order of several metres
from the axis of the extensive air shower. The whole of the
experimental facts may be explained by the idea of equilibrium

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· The Structure of the Extensive Atmospheric Showers at Sea Level

between the electron component and the nuclear active com-
ponent with low energies on one hand and by the energy-flux
of the nuclear avalanche (lavina) of the shower core on the
other hand. There are 7 figures, 4 tables, and 20 references,
12 of which are Soviet.

ASSOCIATION: Fizicheskiy institut im. P.N. Lebedeva Akademii nauk SSSR
(Physics Institute imeni P.N. Lebedev, AS USSR)
Moskovskiy gosudarstvennyy universitet (Moscow State University)

SUBMITTED: December 3, 1957

1.Particles(Airborne)--Measurement   2.Electrons--Distribution
3.Electrons--Properties   4.Mathematics--Applications

Card 3/3

KHRENOV, B. A.

KHERNOV, B. A.

GENERAL DESCRIPTION OF THE MOSCOW UNIVERSITY ARRANGEMENT FOR THE STUDY OF
EXTENSIVE AIR SHOWERS AND PRELIMINARY RESULTS OBTAINED BY IT

S.N. Vernov, G.B. Khristiansen, A.T. Abrosimov, N.N. Goryunov, V.A. Dmitriev,
G.V. Kuliko , Yu.A. Nechin, S.P. Sokolov, V.I. Soloveva, K.I. Soloviev, Z.S. Strugalsky, B.A. Khrenov

1. In late 1957, at the Moscow State University an arrangement was put into opera -
ation for multipurpose studies of extensive air showers of cosmic rays.

2. The arrangement is a complex assembly of simutaneously operating physical
instruments (some 5000 Geiger-Muller counters covering an area of over 100 m^2, some
150 ionization chambers of various shapes covering a total area of 13 m2, and a
diffusion chamber of area 0.04 m^2) and appropriate elctronic equipment and photo-
graphic devices to record the instrument readings when an extensive air shower passes
through the arrangement. Most of this equipment is locted in a specially erected
building. Three rooms of this building (~60 sq.m. in area each) have a ligrt roofing
of not more than 1.5 g/cm^2 and two rooms (25 m^2 and 80 m2) are situated underground
at a depth corresponding to 20 and 40 metres water equivalent.

report presented at the International Cosmic Ray conference, Moscow, 6-11 July 1959.

B.A. KHRENOV

A STUDY OF THE MU-MESON COMPONENT NEAR THE AXIS OF AN EXTENSIVE AIR SHOW
S.N.Vernov, B.A.Khrenov, G.B.Khristiansen

I. The method of correlated hodoscopes was applied in a study of the
following characteristics of the high-energy mu-meson component in
extensive air showers at sea level:
   a) the spatial distrubution of mu-meson fluxes,
   b) the energy spectrum of mu-mesons,
   c) the dependence of the number of mu-mesons of high energy on the
total number of particles in the shower, N.

2. The spatial distribution of mu-meson fluxes is of the following form for
showers with N 10^5 : (2) I/r^n, $n=1+0.2$ $2m$ r $8m$
                                           $n=0.96+0.14$ $8m$ r $100m$

Irregularities are observed near the shower axis in the spatial distribution
of mu-meson flux. These irreularities, which consist in the appearance of
groups of spatially correlated mu-mesons, can by no means be explained by
Poisson fluctuations in the distribution of meon trajectories.

Report presented at the International Cosmic Ray Conference, Moscow, 6-11
July 1959

SOV/120-59-4-5/50

AUTHORS: Bogoslovskiy, G. V., Khrenov, B. A.

TITLE: An Electronic Analogue for Working Up Data on Extensive Air Showers

PERIODICAL: Pribory i tekhnika eksperimenta, 1959, Nr 4, pp 37-40
(USSR)

ABSTRACT: The apparatus is designed to find the axis of the shower and the number of particles from the data provided by a set of counter trays. The probability distributions for the axis and for the number of particles are indicated. The mathematical aspects of the problem are treated first; the particles are assumed to be distributed in accordance with the law

$$f(r_j) = 2 \times 10^{-3} \exp(-r_j/55)/r_j \; ; \; \text{with} \; r_j \; \text{(the distance}$$

from the axis to the j-th counter) in m . The coordinates of the axis are x , y , and the number of particles is j . Each tray contains n counters each of area σ ; the shower fires m_j counters in tray j . Fig 1 shows a unit of the circuit used to calculate the log of the probability function W . The density distribution is imitated by supplying an input as the potential distribution in a tank of electrolyte.

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SOV/120-59-4-5/50

An Electronic Analogue for Working Up Data on Extensive Air Showers

The units have an input resistance of 23 megohms; the inputs
are provided by a set of probes, which set can be moved
about in the tank to locate the axis. The apparatus is
equivalent to 36 trays of counters each with 24 counters;
each tray switch has 25 positions (see Fig 2), which set
the potentials in the electrolyte. The rest of the design
is obvious. Fig 3 compares the exact solutions (continuous
lines) with the approximations (steps). The paper contains
3 figures and 3 Soviet references.

ASSOCIATION: Nauchno-issledovatel'skiy institut yadernoy fiziki MGU
(Nuclear Physics Research Institute, Moscow State University)

SUBMITTED: May 20, 1958.

Card 2/2

ZHDANOV, G.B., glavnyy red.; IVANENKO, I.P., zam.glavnogo red.;
    SYROVATSKIY, S.I., otv.red.toma; KHRENOV, B.A., zam.red.toma;
    GERASIMOVA, N.M., red.; NIKISHOV, A.I., red.; ZATSEPIN, V.I.,
    red.; DORMAN, L.I., red.; TULINOV, V.F., red.; FEDOROV, V.M.;
    VAVILOV, Yu.N., red.; ABRASIMOV, A.T., red.; FRADKIN, M.I.,
    red.izd-va; BRUZGUL', V.V., tekhn.red.

[Radiation belts of the earth. Primary cosmic radiation and its
properties and origin] Radiatsionnyi poias Zemli. Pervichnoe
kosmicheskoe izluchenie, ego svoistva i proiskhozhdenie. Moskva,
Izd-vo Akad.nauk SSSR, 1960. 258 p. (Trudy Mezhdunarodnoi
konferentsii po kosmicheskim lucham, no.3)

                                                        (MIRA 14:2)

1. International Conference of Cosmic Radiation.
            (Cosmic rays)

GERASIMOVA, N.M., otv.red.toma; NIKISHOV, A.I., zamestitel' red.toma;
ZHDANOV, G.B., glavnyy red.; IVANENKO, I.P., zamestitel' glavnogo
red.; ZATSEPIN, V.I., red.; KHRENOV, B.A., red.; DORMAN, L.I., red.;
TULINOV, V.F., red.; SYROVATSKIY, S.I., red.; FEDOROV, V.M., red.;
VAVILOV, Yu.N., red.; ABROSIMOV, A.T., red.; GUROV, K.P., red.izd-va;
BRUZGUL', V.V., tekhn.red.

[Transactions of the International Conference on Cosmic Rays] Trudy
Mezhdunarodnoi konferentsii po kosmicheskim lucham. Moskva, Izd-vo
Akad.nauk SSSR. Vol.1. [Nuclear interactions at energies of 10^{11}-10^{14} ev.]
IAdernye vzaimodeistviia pri energiiakh 10^{11}-10^{14} ev. 1960. 335 p.
(MIRA 13:9)

1. Mezhdunarodnaya konferentsiya po kosmicheskim lucham. Moscow, 1959.
(Nuclear reactions)

ZHDANOV, G.B., glavnyy red.; IVANENKO, I.P., zam.glavnogo red.; DORMAN,
L.I., otv.red.toma; TULINOV, V.F., zam. redaktora toma; GERASI-
MOVA, N.M., red.; NIKISHEV, A.I., red.; ZATSEPIN, V.I., red.;
KHRENOV, B.A., red.; SYROVATSKIY, S.I., red.; FEDOROV, V.M.,
red.; VAVILOV, Yu.N., red.; ABROSIMOV, A.T., red.; GUS'KOV, G.G.,
red.izd-va; BRUZGUL', V.V., tekhn.red.

[Transactions of the International Conference on Cosmic Rays] Trudy
Mezhdunarodnoi konferentsii po kosmicheskim lucham. Moskva, Izd-vo
Akad.nauk SSSR. Vol.4. [Variations in the intensity of cosmic rays]
Variatsii intensivnosti kosmicheskikh luchei. 1960. 362 p.
(MIRA 13:10)

1. Mezhdunarodnaya konferentsiya po kosmicheskim lucham. Moscow,
1959. 2. Magnitnaya laboratoriya AN SSSR, Moskva (for Dorman).
(Cosmic rays)

ZHDANOV,,G.B.,.glavnyy red.;;IVANENKO, I.P., zam.glavnogo:red.; ZATSEPIN,
     V.I., otv.red.toma; KHRENOV, B.A., zam.red.toma; GERASIMOVA, N.M.,
     red.; NIKISHOV, A.I., red.; DORMAN, L.I., red.; TULINOV, V.F.,
     red.; SYROVATSKIY, S.I., red.; FEDOROV, V.M., red.; VAVILOV, Yu.N.,
     red.; ABROSIMOV, A.T., red.; GUROV, K.P., red.izd-va; BERKGAUT,
     V.G., red.izd-va; BRUZGUL', V.V., tekhn.red.

[Extensive air showers and cascade processes] Shirokie atmosfernye
livni i kaskadnye protsessy. Moskva, Izd-vo Akad.nauk SSSR, 1960.
351 p. (Trudy mezhdunarodnoy konferentsii po kosmicheskim lucham,
no.2).   (MIRA 13:12)

1. International Conference of Cosmic Radiation.
              (Cosmic rays)

KHRENOV, B.A.

⑧

31519
S/627/60/002/000/001/027
D299/D304

3.2410(1559, 2205, 2705, 2805)

AUTHORS: Vernov, S. N., Khristiansen, G.B., Abrosimov, A. T.,
              Goryunov, N. N., Dmitriyev, V. A., Kulikov, G. B.,
              Nechin, Yu. A., Sokolov, S. P. (deceased), Solov'yeva,
              V. I., Solov'yev, K. I., Strugals'kiy, Z. S., and
              Khrenov, B. A.

TITLE: General description of the setup used for studying ex-
              tensive air showers and the provisional results ob-
              tained

SOURCE: International Conference on Cosmic Radiation. Moscow,
              1959. Trudy. v. 2. Shirokiye atmosfernyye livni i kas-
              kadnyye protsessy, 5-16

TEXT: A complex experimental setup was installed at Moscow State
University, consisting of a simultaneously operating physical appa-
ratus plus the corresponding radiotechnical equipment and photo-
graphical recording devices. The setup incorporates over 5000 Gei-
ger-Müller counters (forming a hodoscope), about 150 ionization

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General description of the setup...   S/627/60/002/000/001/027
                                             D299/D301

chambers and a large diffusion chamber. The setup is designed for a
comprehensive and simultaneous investigation of all the basic compo-
nents (electrons and photons, nuclear-active particles and μ-mesons)
of extensive air showers at sea level. The setup was designed in 2
different configurations: the first at the end of 1957, and the se-
cond at the beginning of 1959. Below, only the results obtained by
means of the first setup are considered. The setup was located in
a special building and in 10 motile laboratories. The showers were
registered by the system of hodoscoped counters. Part of the coun-
ters were shielded (those for detecting the nuclearactive particles
and the μ-mesons) and the other counters were not shielded. The io-
nization chambers served to determine the lateral distribution of
the electron-photon component and of the nuclearactive component.
The microstructure of the electron component was studied by means
of the diffusion chamber. Special measures were taken to ensure
continuous and prolonged operation of the setup. The main units of
the setup were automatically controlled, in particular the supply
units and the photography system. The operation of the setup (as a
whole) was controlled (triggered) by a selection system; in parti-

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General description of the setup ... D299/D304

cular, the showers were selected in accordance with the density of
the electron flow and of the μ-mesons. The setup was in operation
for about 2500 hours, yielding a large amount of experimental data
which are still being processed. The probability theory (Baye's
theorem) was used for determining the (x,y)-axes and the number of
particles N of the shower; in addition the distribution function
f(r) as well as other distribution functions were determined (r de-
noting distance). The values of x, y and N were found by means of
a special electronic simulator. The density distribution of elec-
trons and mesons was determined by means of formula

$$W(\rho) = \prod_1 \left[1 - \exp(-\rho\sigma_i)\right]^{m_i} \cdot \exp\left[-\rho\sigma_i(n_i - m_i)\right]$$

where m_i is the number of counters which operate over an area σ_i,
and n_i – the overall number of such counters. The energy E of the
electron-photon component was determined by means of ionization

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General description of the setup ...   31519
S/627/60/002/000/001/027
D299/D304

chambers, shielded with lead (up to 5 cm thick). A very comprehen-
sive picture of the particles and energies was obtained for showers
whose axes fell within the system of 128 cubic detection chambers.
The setup permits observing the central part of an atmospheric
shower, whereby its several layers are simultaneously observed;
this corresponds to the individual observation of the electron-
photon, nuclearactive and μ-meson components. The processed mate-
rial already yielded a fairly detailed picture of the structure of
extensive air showers at sea level. Thus, the lateral distribution
of particle flow in the individual showers was ascertained. It was
found that the lateral distribution varies (in the 1 to 25 m range)
from shower to shower; the average distribution is, in the range of
5 cm to 100 m, as follows:

$$\rho(r) = \begin{cases} \dfrac{K_1 N}{r^{0,6}} & K_1 = 3,3 \cdot 10^{-3}, \ 0,05 < r < 0,3 \text{ m} \end{cases}$$

(cont'd)

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General description of the setup ...   31519
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D299/D304

$$\left| \frac{K_2 N}{r} \cdot e^{-\frac{r}{60}} \right. , K_2 = 2 \cdot 10^{-3}, \ 0.3 \langle r \langle 100 \ m$$

The lateral distribution of the electron-photon components also fluctuates from shower to shower. At distances smaller than 1.5 m, these fluctuations are particularly sharp. The nuclearactive components also exhibits considerable energy fluctuations. The fluctuations in the high-energy μ-mesons were not yet analyzed. The energy of the electron-photon component E_{eph} was calculated for a shower with number of particles equal to $(2.7 \pm 0.2) \cdot N\beta$, where β is the critical energy for air (72 Mev). The above value was obtained with an accuracy of appr. 30%. It was found that the energy of the nuclearactive component $E_n \cong (0.5 \ to \ 1.0) E_{eph}$. This value is, however, subject to considerable fluctuations and the experimental data are as yet insufficient to determine the contribution of the

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General description of the setup...

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nuclearactive component in showers. In addition, the above-mentioned fluctuations severely delimit the choice of a theoretical model for the development of showers. Particular attention was devoted to the structure of the shower in the immediate vicinity of its axis, where the particles of highest (for the particular shower) energy should be concentrated. This led to the discovery of a new effect: Groups of particles (from 4 to 20) travel in narrow beams (not exceeding 8 cm in diamebr) in the neighborhood of the axis (or along the axis itself), whereby their lateral distribution shows that the beams are not due to Poisson fluctuations. The new effect can be explained as follows: Either the beam is the core of a "young" electron-photon shower which originates from a high-energy π^0-meson at a certain distance from the apparatus, or the beam consists of μ-mesons. These two possibilities are discussed. The observed irregularity in the lateral distribution of μ-mesons in the vicinity of the shower axis might be related to the new effect. There are 6 figures and 2 tables.

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                                       31519
                                       D299/D304

ASSOCIATION: Nauchno-issledovatl'skiy institut yadernoy fiziki MGU, Moskva (Scientific Research Institute of Nuclear Physics Moscow State University, Moscow)

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S/627/60/002/000/016/027
D299/D304

3.2410 (1265, 2705, 2805)

AUTHORS: Vernov, S. N., Tulupov, V. I., Khrenov, B. A., and
             Khristiansen, G. B.

TITLE: Investigating high-energy μ-meson component of exten-
             sive air showers

SOURCE: International Conference on Cosmic Radiation. Moscow,
             1959. Trudy. v. 2. Shirokiye atmosfernyye livni i kas-
             kadnyye protsessy, 169-180

TEXT: The selection of μ-mesons of various energies was carried
out by recording them at various depths of the absorber. The pecu-
liar feature of the experiments consisted in the need to select
showers, whose axes pass at various distances from the meson det-
ectors, so as to study the space distribution of the meson flow.
Thereby, the distance between the underground detectors and the
shower axis recorded at the surface, may largely depend on the in-
clination of the shower axis. The apparatus made it possible to
determine the mean density of meson flow with treshold energies

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Investigating high-energy ...

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D299/D304

E_μ equal to 0.4, 5, and 10 Bev, at distances of 100, 25, and below 25 m, for showers of various number of particles. The detectors with a large sensitive area permitted observing the peculiarities of meson distribution in the various showers. The apparatus was in operation for approximately 2000 hours. The energy spectra of the μ-mesons and their lateral distribution for distances of 3 - 100 m from the shower axis were obtained. It was found that for showers with $N = 2 \cdot 10^5$, the lateral distribution of μ-mesons with $E_\mu \geqslant 10$ Bev has an exponent $n \leqslant 1$ for distances up to 100 m. This means that μ-mesons of such energies are mainly found outside a circle of radius $r = 100$ m. Further, the irregularities of meson-distribution at a depth of 40 m were studied in individual showers by means of meson detectors of total area 3.1 m^2. Irregularly distributed meson-groups were observed. In all, 17 such groups were recorded in 14 showers, during 800 hours of operation of the detectors. The pertinent experimental results are listed in tables. It was found that the meson groups appear in showers which do not differ from "aver-

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age" showers with respect to the total meson-flow. The distance be-
tween the meson group and the shower axis did not exceed 3 m for

showers with $N = 2 \cdot 10^5$. A comprehensive knowledge of the high-ener-
gy meson component was obtained, in particular with respect to me-
son flow in the vicinity of the shower axis, where the energy of
the μ-mesons exceeds 10 Bev. By comparing the number of mesons at
mountain altitude and at sea level, the conclusion is reached that
μ-mesons with $E_\mu > 10$ Bev. are effectively generated at high altitudes
(above 3800 m), acquiring a sufficiently large transverse momentum.
The character of the lateral distribution of μ-mesons near the
shower axis is determined by the character of meson generation ac-
cording to altitude. Computations were carried out of meson distri-
bution near the axis ($r < 25m$), with $E_\mu > 10$ Bev, for 2 models of ex-

tensive shower development. Further, various interpretations are
proposed for the appearance of μ-meson groups in the vicinity of
the shower axis. The angular distribution of π-mesons in nuclear
interactions has a substantial effect on the lateral distribution
of μ-mesons with $E_\mu > 10$ Bev. The majority of μ-mesons of such ener-

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gies are generated at altitudes of 6 - 8 km above sea level. The dependence of the number of μ-mesons with $E_\mu > 10$ Bev. on the number of particles in the shower, in the circle r = 25 m, is expressed by $N^{0.6 \pm 0.1}$ (for the range N = 10^4 to $5 \cdot 10^5$). The meson distribution (with $E_\mu > 10$ Bev.) in showers with N = $2 \cdot 10^5$ is expressed by $\rho_\mu =$ = K/r^n, n = 0.8 + 0.2, for distances of 3 to 10 m from the shower axis. There are 6 figures, 6 tables and 10 references: 8 Soviet-bloc and 2 non-Soviet-bloc. The references to the English-language publications read as follows: B. Edwards, J. Losty, D. H. Perkins, P. Pinkau, J. Reynolds. Phil. Mag., 3, 237, 1958; A. Ueda, N. Ogita. Progr. Theor. Phys., 18, 269, 1957.

Card 4/4

KHRENOV, B. A., KULIKOV, G. U., SOLOVYEVA, V. I., KHRISTIANSEN, G. B., BELYAYEVA, J. F.,

ATRASHKEVICH, V. J., DMITRIYEV, V. A., ABROSIMOV, A. T., NECHIN, YU. A.

"The Structure of Extensive Air Showers at Sea Level."

report submitted for the Intl. Conf. on Cosmic Rays and Earth Storm (IUPAP)
Kyoto, Japan 4-15 Sept. 1961.

KHRENOV, B. A., KHRISTIANSEN, G. B., BERNOV, S. N., DMITRIYEV, V. A.,

Ghalam-Sadik, M., Khva, Ly-Don.

"On Mu-Meson Beams in EAS and the Investigation of Mu-Meson
Spectrum."

report submitted for the Intl. Conf. on Cosmic Rays and Earth Storm (IUPAP)
Kyoto, Japan 4-15 Sept. 1961.

27183

S/056/61/041/002/004/028
B102/B205

3.2410

AUTHORS: Vernov, S. N., Solov'yeva, V. I., Khrenov, B. A.,
Khristiansen, G. B.

TITLE: Fluctuations of the muon flux in extensive atmospheric
showers

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 41,
no. 2(8), 1961, 340 - 353

TEXT: The study of fluctuations of the muon flux in extensive atmospheric
showers is very interesting, since the fluctuations accompanying the
formation of avalanches of high-energy nuclear-active particles in the
atmosphere, as well as the applicability of the various models of shower
formation can be estimated from their character. This article gives a
detailed presentation of the results of an investigation of muon-flux
fluctuations in extensive atmospheric showers, which were carried out
with a special device for comprehensive studies of such showers, made
available by Moskovskiy gosudarstvennyy universitet (Moscow State Uni-
versity). First, the authors give a detailed description of the experi-

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Fluctuations of the muon flux...

mental arrangement which used numerous Geiger-Müller counters in hodos-
copic arrangement. Fig. 2 shows a muon detector. Detectors of this type,
used for measurements on the earth surface, had a total area of 4.75 m^2;
at a depth of 20 m water equivalent, it was 3.2 m^2, and at 40 m water
equivalent, 6.3 m^2. The arrangement was designed in such a way that six-
fold coincidences could be recorded. Showers with $N > 10^5$, in which the
numbers of muons with $E > 4 \cdot 10^8$ ev were determined, were examined more
closely. In order to eliminate the nuclear-active effect, only the
records of those detectors were taken into account, which were more than
50 m away from the shower axis. The arrangement made it possible to
measure the total number of shower particles and the number of muons in
the shower simultaneously. The showers investigated were grouped as
follows:

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Fluctuations of the muon flux...

A - Detectors on the earth surface

$$\begin{cases} N = (2-5)\cdot 10^6 \\ N = (5-10)\cdot 10^6, \\ N \geqslant 10^7 \end{cases}$$

Detectors

$$\begin{cases} N = (2-4)\cdot 10^6 \\ N \geqslant 4\cdot 10^6 \end{cases},$$

Detectors B

$$\begin{cases} N = (1-2)\cdot 10^6 \\ N = (2-4)\cdot 10^6 . \\ N \geqslant 4\cdot 10^6 \end{cases}$$

The distribution of events with respect to the ratios q/p (q - number of recorded muons, p - average number of muons to be expected) for the groups (A: $N \geqslant 5\cdot 10^6$; Б :N $\geqslant 4\cdot 10^6$; B: $N \geqslant 4\cdot 10^6$) is given in a table. Conclusions: The slight fluctuations of the muon flux in showers with a given number of particles, which were observed experimentally, contradict the conception of the development of extensive air showers proposed by T. E. Cranshaw, and A. M. Hillas in a report delivered at the International Conference on Cosmic Particles. The fact that the experimentally

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Fluctuations of the muon flux...

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observed fluctuations of the muon flux do not exceed the theoretically predicted fluctuations (theory takes into account only fluctuations at the altitude at which the primary shower-producing particle undergoes its first interaction) corroborates theory. Calculations show that in the case of a shower developing without fluctuation, the form of distribution with respect to the muon number n, in a shower with a given number of particles is highly sensitive to the quantity $\varepsilon = (\Lambda + B)/\lambda - \gamma' - 1$. Since Λ and γ' are known, the value of λ can be estimated from the form of distribution with respect to n, (λ is the interaction mean free path of the ultrahigh-energy particles releasing the showers. In order to obtain the exact distribution of muon fluxes, it is necessary to improve the experimental conditions. The authors thank I. P. Ivanenko for a discussion, and K. I. Solov'yev, V. Sokolov, Ye. Shein, V. Putintsev, I. Vasil'chikov, V. Nazarov, G. Degtyareva, N. Proshina, and I. Massal'skaya, co-workers of MGU, for assistance. There are 4 figures, 4 tables, and 8 references: 7 Soviet-bloc and 1 non-Soviet-bloc.

ASSOCIATION: Institut yadernoy fiziki Moskovskogo gosudarstvennogo univer-
              siteta (Institute of Nuclear Physics of Moscow State Uni-

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Fluctuations of the muon flux...   17283   S/056/61/041/002/004/028
                                                     B102/B205

                        versity)
SUBMITTED: March 13, 1961
Legend to the Table: (1), (3), (6): Experimental distributions;
(2), (4), (7): distribution to be expected from the formula

$$\sum_{q=0}^{p_i/3} W(q), \qquad (\text{для } q/p = 0 \div \tfrac{1}{3}),$$

$$\hspace{10em} (2)$$

$$\sum_{q=p_i/3}^{2p_i/3} W(q) \quad (\text{для } q/p = \tfrac{1}{3} \div \tfrac{2}{3}), \text{ и т. д.}$$

(8): distribution to be expected from the factor given in column 5 and
from the statistical fluctuations. The last line but one gives q/p of all
events.

Card 5/5

24.6700

AUTHOR: Khrenov, B. A.

TITLE: Investigation of the high-energy muon fluxes in extensive
               air showers

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 41,
               no. 5(11), 1961, 1402-1411

TEXT: This is a continuation of a work carried out at the Moskovskiy
gosudarstvennyy universitet (Moscow State University) between 1958 and 1960.
The author presents experimental results on the spatial distribution of the
muon flux, on its dependence on the total number of shower particles, on
the muon energy spectrum between 5 and 10 Bev, and on the muon flux density
spectrum. These data had been obtained by means of apparatus described by
S. N. Vernov, V. I. Solov'yeva, B. A. Khrenov, G. B. Khristiansen (ZhETF,
41, 340, 1961), by G. V. Kulikov, G. B. Khristiansen (ZhETF, 35, 635, 1958),
by G. V. Bogoslovskiy, B. A. Khrenov (PTE, 4, 37, 1959), and by
L. N. Korablev (PTE, 2, 56, 1956). The muon flux density grew linearly with
the logarithm of the particle number N for the energy ranges ($E \geqslant 5$ and

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E $\geqslant$ 10 Bev) and for R = 25 m and 80 m. R denotes the distance from the intersection point of the shower axis through the Earth's surface to the vertical line through the muon detectors which were placed at 20 and 40 m water equivalent under the Earth's surface. If these functions are written in the form $\rho(N) \sim N^{\alpha}$, then α is found to be 0.85 $\pm$ 0.10, independently of R. This indicates that the spatial distribution of the muon flux does not depend on the particle density N. The spatial distribution of the muon flux as a function of the distance r between the muon detector and the shower axis may be described by $\rho(N,r) = kN^{\alpha}r^{-n}\exp(-r^2/r_0^2)$, if n = 0.7 $\pm$ 0.1, α = 0.85 $\pm$ 0.1, and k = 5.8$\cdot 10^{-5}$, r_0 = 195 $\pm$ 15 for E $>$ 5 Bev, and k = 4.1$\cdot 10^{-5}$, r_0=155$\pm$15 for E $>$ 10 Bev. From these data, the overall muon flux is calculated to be $N_{\mu} = \pi kr_0^{2-n} \Gamma(1 - n/2)N^{\alpha}$. For E $\geqslant$ 5 Bev N_{μ} = 0.24 $N^{0.85}$ and for E $\geqslant$ 10 Bev, N_{μ} = 0.13 $N^{0.85}$. The density spectrum is interrelated with the I(m,s) spectrum approximately by I(m,s) = Bs$^{\kappa'}$ (m - κ' - 1)!/m!. This is derived from the relation $I(\rho)d\rho=B\rho^{-\kappa'-1}d\rho$.

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B109/B102

Investigation of the high-energy...

m is the number of muons passing through the detector area s.

$\varkappa = \log \left[I_1(m,s_1)/I_2(m,s_2) \right] /\log (s_1/s_2)$; its values for energies $\geqslant 10$ Bev and for two different s-values are given in Table 2 (time of measurement $= 1000$ hr). $B = 0.8$ hr^{-1}m^{-4}. Similar conditions are found for $E \geqslant 5$ Bev ($B = 1.3$ hr^{-1}m^{-4}). The results proved to be inconsistent with those obtained by E. L. Andronikashvili and M. F. Bibilashvili (Ref. 5: ZhETF, 32, 403, 1957). This is interpreted as due to inaccurate determination of the particle number in a shower in Ref. 5. Professor S. N. Vernov, A. Yu. Fomin, N. I. Kvitek, M. Muminov, M. Zhadin K. I. Solov'yev, V. I. Putintsev, V. K. Sokolov, Ye. V. Shein, G. Dyagtyareva, N. Proshina, and I.Massal'skaya are thanked for their interest and help. Mention is made of Fukui, Khasegava, Matano, Miura, Oda, Ogita, Suga, Tanakhashi, Tanaka (Tr. Mezhdunar. konf. po kosmicheskim lucham, iyul' 1959 g., t. 2, Izd. AN SSSR, 1960 g.). There are 4 figures, 2 tables, and 15 references: 13 Soviet and 2 non-Soviet. The two references to English-language publications read as follows: E. P. George, J. W. Mac Annuf, J. W. Sturgess. Proc. Phys. Soc., 66A, 345, 1953; P. H. Barret, L. M. Bollinger, G. Cocconi, Y. Eisenberg,

Card 3/6

Investigation of the high-energy...

26694.
S/056/61/041/005/009/038
B109/B102

K. Greisen. Rev. Mod. Phys.,24, 133, 1952.

ASSOCIATION: Institut yadernoy fiziki Moskovskogo gosudarstvennogo
universiteta (Institute of Nuclear Physics of Moscow State
University)

SUBMITTED: May 20, 1961

Card 4/6

KHRENOV, B.A.

3,2 4/0 (2205, 2705, 2805)

J/550

S/048/62/026/005/014/022
B102/B104

AUTHORS: Vernov, S. N., Khristiansen, G. B., Belyayeva, I. F.,
Dmitriyev, V. A., Kulikov, G. V., Nechin, Yu. A.,
Solov'yeva, V. I., and Khrenov, B. A.

TITLE: The primary cosmic-ray component at superhigh energies and
some peculiarities of its interaction with nuclei of air
atoms

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya,
v. 26, no. 5, 1962, 651-657

TEXT: The paper is a report on experiments with the Moscow University
large apparatus (area $4 \cdot 10^4$ m^2) for comprehensive studies of extensive
air showers induced by high-energy cosmic particles. The charged-particle
detectors (Geiger counters in hodoscope arrangement) cover an area of
110 m^2, the muon detectors (2-3 counter layers shielded with lead and iron,
in hodoscope arrangement) more than 12 m^2, 6.3 m^2 of which are under

Card 1/3

4

The primary cosmic-ray component ...

40 m water equivalent. The nuclear-active-particle detectors form a system of 128 ionization chambers (8 m^2) shielded by lead and graphite filters. The number of muons produced in charged-pion decay was estimated (the pions were assumed to be formed in gamma-quantum photoeffect on nuclei of air atoms): $N_\mu^f(E) \leqslant \sigma_o E_o/1.8(1-\alpha)E$, $\alpha \leqslant 0.5$, $\sigma_o < 10^{-3}$; for $E_o \sim 10^{16}$ ev and $E_\mu = 10^{10}$ ev $(\alpha = 0.5)$, $N_\mu^f(10^{10}) < 10^3$. The number N_μ^n of muons in nuclear showers was measured. For showers with $N = 7 \cdot 10^6$ a mean number of $8 \cdot 10^4$ muons with $E \geqslant 10^{10}$ ev is to be expected. The spatial muon flux distribution was determined for these two types of showers $(\rho_\mu^n$ and $\rho_\mu^f)$. In the case of a simple model of air shower production (Suppl. Nuovo Cimento, 2, 649, 1958), an analysis of the experimental data yields $N = k_e E_o \exp(-x + x_m + x_o)/\Lambda$; E_o is the energy of the primary particle, x_o is the depth of its first interaction, $x_m = B\log E_o$ (x - depth of observation), N is the total number of

Card 2/4

The primary cosmic-ray component ...

S/048/62/026/005/014/022
B102/B104

shower particles; the number of muons $N_\mu = k_\mu E_0^\alpha$; $\Lambda = 200$ g/cm^2, B = 30 g/cm^2 and $\alpha = 0.8 \pm 0.1$. If the primary energy spectrum has the shape $A E_0^{-(\gamma+1)} dE_0$, at fixed N the N_μ distribution has the shape

$$N_\mu^{1/\lambda\left(\frac{\lambda+B}{\Lambda}-\gamma-1\right)} dN_\mu,$$ λ being the mean free path with respect to inter-action. Comparison between experiment and theory yields $\lambda = (85\pm5)$ g/cm^2, as an upper limit. For charged muons their energies (E_μ) and numbers (n_-) were measured and calculated for several altitudes H; W is the probability for a charged pion produced at H decays without interacting with an air nucleus. The results indicate that in $\sim 3\%$ of all cases nuclear interaction is accompanied by a production of narrow beams of great numbers of charged pions. There are 8 figures.

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3, 2410 (2205, 2705, 2805)

37551
S/048/62/026/005/015/022
B102/B104

AUTHORS: Belyayeva, I. F., Solov'yeva, V. I., Khrenov, B. A.,
             and Khristiansen, G. B.

TITLE: Extensive air showers induced by high-energy photons

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya,
             v. 26, no. 5, 1962, 658-660

TEXT: Photon-induced extensive air showers (e.a.sh.) (Nuovo Cimento 17,
625, 1960) must differ from heavy-particle induced e.a.sh. by the number
of penetrating particles. The upper limit of the number of muons N_μ in
a photon-induced e.a.sh. and the spatial muon distribution are

estimated for $E_{phot} = 10^{10}$ ev and $N = 10^7$ at sea level. The muons are
assumed to be produced in $\pi^\pm$ decay only, the $\pi^\pm$ being the result of photo-
nuclear interaction. Muon pair production is ignored.

$N_\mu(>E) \leqslant 0.8 \cdot 10^{-3} E_o/E$. The spatial meson distribution at sea level

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Extensive air showers induced by ...

S/048/62/026/005/015/022
B102/B104

is determined for mesons with $E > 1 \cdot 10^{10}$ ev. The transverse momenta of the $\pi^{\pm}$ produced are assumed to satisfy the law $p_{\perp}^{2} \exp\left[-(p_{\perp}/p_{0})^{2}\right]$ with $p_{0} = 1 \cdot 10^{8}$ ev. The distribution curves were found to be similar for electron-photon and ordinary showers, the densities at axial distances between 10 and 100 m differ by a factor of ~ 100; it is concluded that the muon density in photon-induced e.a.sh. will be $\sim 1\%$ of that in ordinary showers with $N \sim 1 \cdot 10^{7}$ at sea level and distances up to 100 m from the shower axis. An analysis of the relation between the number of recorded showers and that of recorded muons showed that of 126 showers with $4 \cdot 10^{6} \leqslant N \leqslant 2 \cdot 10^{7}$ all those which could have been photon-induced were recorded. This indicates a 75% probability that $\alpha < 0.01$. There are 2 figures.

ASSOCIATION: Nauchno-issledovatel'skiy institut yadernoy fiziki Moskovskogo gos. universiteta im. M. V. Lomonosova (Scientific Research Institute of Nuclear Physics of Moscow State University imeni M. V. Lomonosov)

Card 2/2

37553

3.2410 (2205, 2705, 2805)

AUTHOR: Khrenov, B. A.

TITLE: Study of the high-energy muon component in extensive
            atmospheric showers at sea level

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya,
            v. 26, no. 5, 1962, 689 - 691

TEXT: Experimental results are given on the spatial distribution of muons,
the dependence of the muon fraction on the total number of particles in a
shower, the absolute muon current in a shower with a certain number of
particles, and the muon current density spectrum. The experimental appara-
tus, a set of Geiger-Müller counters, was described by S. N. Vernov et al.
(Zh. eksperim. i teor. fiz., 41, 340, 1961). The muon current density
obeys the law $\rho(N,r) = kN^{\alpha}r^{-n}\exp(-r^2/r_0^2)$, where $k = 5.8 \cdot 10^{-5}$; $n = 0.7 \pm 0.1$;
$\alpha = 0.85 \pm 0.1$; $r_0 = 195 \pm 15$ m at $E \geqslant 5$ Bev and $k = 4.1 \cdot 10^{-5}$; $r_0 = 155 \pm 15$ m

Card 1/2

Study of the high-energy muon ...

S/048/62/026/005/021/022
B108/B102

at $E \geqslant 10$ Bev. $N = 3.5 \cdot 10^4 - 2 \cdot 10^7$, $r = 4 - 250$ m away from the shower axis. The spatial distribution of the muon current at $E \geqslant 10$ Bev is not consistent with literature data. This is attributed to inaccurate measurement. The total energy of a current of muons with $E \geqslant 5$ Bev in a shower with $N = 10^6$ is $7.2 \cdot 10^{14}$ ev, i. e., about 7% of the primary particle energy. There are 2 figures.

ASSOCIATION: Nauchno-issledovatel'skiy institut yadernoy fiziki Moskovskogo gos. universiteta im. M. V. Lomonosova (Scientific Research Institute of Nuclear Physics of the Moscow State University imeni M. V. Lomonosov)

Card 2/2

$\mathcal{J}4\ 6700$

AUTHORS: Vernov, S. N., Li Don Khva, Khrenov, B. A., Khristiansen, G. B.

TITLE: Muon beams in extensive air showers

TEXT: The underground measurements of cosmic-particle distributions described in Ref. 1 (ZhETF, 37, 1252, 1959) have been continued. The spatial muon distributions have been measured at a depth of 40 m water-equivalent by means of Geiger counters in hodoscope circuit. The total area covered by the counters was 1.2 m^2. The spatial muon distribution was characterized by the distance D between the muon tracks in dependence on M (number of recording counters in the middle row), N (number of particles in the shower) and R (distance from the shower axis on the earth's surface). The showers recorded were divided into two groups: R <30m (N=5·10^4-10^6), and R >50m (N - 10^6 - 2·10^7). The meson track distribution determined was analyzed

Card 1/2

Muon beams in ...

S/056/62/042/003/018/049
B102/B138

by the Monte-Carlo method. Since in the central region of extensive air showers ($r < 30$ m from the shower axis) the muon trajectiories are not independent of each other, it is concluded that there exist pairs and groups of mesons related with each other. A characteristic feature of the central region is narrow muon groups ($d \sim 0.2$m), muon beams, whose number rapidly increases with N. For $N > 10^6$ several narrow muon beams were recorded and the distance between them reached several meters. It is probable that these beams originate in nuclear interactions. For an exact interpretation measurements with large-area arrangements (~ 10 m^2) would be necessary. There are 4 figures, 5 tables, and 7 references: 6 Soviet and 1 non-Soviet.

ASSOCIATION: Institut yadernoy fiziki Moskovskogo gosudarstvennogo universiteta (Institute of Nuclear Physics of Moscow State University)

SUBMITTED: September 30, 1961 (initially) December 9, 1961 (after revision)

Card 2/2

L 40709-65 EWO(J)/EWT(m)/FCC/T   IJP(c)

ACCESSION NR: AP5012318   UR/0048/64/028/011/1886/1893

AUTHOR: Vernov, S. N.; Khristiansen, G. B.; Abrosimov, A. T.; Belyayeva, I. F.;
Dmitriyev, V. A.; Kulikov, G. V.; Nechin, Yu. A.; Solov'yeva, V. I.; Khrenov, B.A.

TITLE: New data on the study of broad atmospheric showers using a complex
apparatus /Report of All-Union Meeting on Cosmic Rays Physics, held in Moscow
from October 4 to 10, 1963_/

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v. 28, no. 11, 1964, 1886-1893

TOPIC TAGS: cosmic ray shower, nuclear particle, nuclear physics apparatus

ABSTRACT: Experiments are described that were conducted at Moscow State University
on a complex apparatus for the study of broad atmospheric showers and the mu-
meson component of cosmic rays. The apparatus gave simultaneous information on the
electron-photon, mu-meson, and nuclear-active components of broad atmospheric
showers in each individually recorded shower. Orig. art. has: 9 graphs, 3 tables.

ASSOCIATION: Nauchno-issledovatel'skiy institut yadernoy fiziki Moskovskogo
gosudarstvennogo universiteta im. M. V. Lomonosova (Scientific Research Institute
of Nuclear Physics, Moscow State University)

SUBMITTED: 00   ENCL: 00   SUB CODE: AA, NP
NO REF SOV: 003   OTHER: 006   JPRS

Card 1/1

NSEN, G. B.; ABROSIMOV, A. M.; KHRENOV, B. A.; ATRASHKEVICH, V. B.;
ROV, G. V.; SOLOVIYEVA, V.I.; FOMIN, Yu. A.

The cosmic ray primary radiation of ultra high energy.

Report submitted for the 8th Intl. Conf. on Cosmic Rays (IUPAP), Jaipur, India,
2-   Dec 1963

VERNOV, S.N.; KHRISTIANSEN, G.B.; ABROSIMOV, A.T.; BELYAYEVA, I.F.;
DMITRIYEV, V.A.; KULIKOV, G.V.; NECHIN, Yu.A.; SOLOV'YEVA, V.I.;
KHRENOV, B.A.

Recent data on the study of extensive air showers by means of
an elaborate setup. Izv. AN SSSR. Ser. fiz. 28 no.11:1886-
1893 N '64.   (MIRA 17:12)

1. Nauchno-issledovatel'skiy institut yadernoy fiziki Moskovskogo
gosudarstvennogo universiteta.

2c

L 23402-65   EWT(1)/EWG(v)/FCC/EEC-4/EEC(t)/EWA(h)   Po-4/Pe-5/Pq-4/Pae-2/Peb/P1-4
ACCESSION NR: AP5002095 GW/WS   S/0048/64/028/012/1934/1941

AUTHOR: Khristiansen, G. B.; Abrosimov, A. T.; Atrashkevich, V. B.;
Kulikov, G. V.; Solov'yeva, V. I.; Fomin, Yu. A.; Khrenov, B. A.

TITLE: Primary cosmic radiation of superhigh energy

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v. 28, no. 12, 1964,
1934-1941

TOPIC TAGS: atmospheric shower, shower spectrum, primary energy
spectrum, cosmic ray, atomic number, μ meson, cosmic ray diffusion,
magnetic field, magnetic rigidity, proton, nucleus, diffusion coeffi-
cient

ABSTRACT: The spectrum investigation of large atmospheric showers may
be made by means of the number of particles which is possible to study
using a complex large-scale facility. The spectrum of large atmospheric
showers near sea level changes its form sharply with the change in
the total number N of particles. The transition of cosmic radiation
from the shower spectrum to the primary energy spectrum is performed
using a model of the development of atmospheric showers. The develop-

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L 23402-65
ACCESSION NR: AP5002095

ment depends upon the number of particles and their atomic number A. These parameters were obtained by analyzing the fluctuations of μ-meson flux measured in the complex facility. The distribution of the meson number depends upon the form of the primary energy spectrum, which is characterized by the exponent γ. Acceleration and diffusion of cosmic rays occur when both a change in the energy spectrum and a change in the composition of rays take place simultaneously. The diffusion of cosmic rays takes place in a magnetic field where the diffusion coefficient is specified by magnetic rigidity, which is equal to $2\varepsilon/300H$ for nuclei and $\varepsilon/300H$ for protons (ε is the energy of a nucleon). A table in the original article contains the percentage of galactic cosmic radiation of various energies. This table shows that the increase of energy causes an increase of heavy nuclei in cosmic radiation of the Galaxy. A decrease in the percentage of light nuclei a and L with the increase in energy is caused by the higher diffusion coefficient. The number of μ-mesons computed theoretically agreed with experimental data up to 10^{15} ev of the primary particles. At energies greater than 10^{17} ev, the experimental data showed more protons and light nuclei than the theory purports. Orig. art. has: 4 figures, 2 tables, and 12 formulas. [EG]

Card 2/3

I. 23402-65
ACCESSION NR: AP5002095

ASSOCIATION: none

SUBMITTED: 00   ENCL: 00   SUB CODE: AA

NO REF SOV: 008   OTHER: 001   ATD PRESS: 3174

Card 3/3

VERNOV, S.N.; KHRISTIANSEN, G.B.; ABROSIMOV, A.T.; ATRASHKEVICH, V.B.;
     BELYAYEVA, I.F.; VEDENEYEV, O.V.; DMITRIYEV, V.A.; KULIKOV, G.V.;
     NECHIN, Yu,A.; SOLOV'YEVA, V.I.; SOLOV'YEV, K.I.; FOMIN, Yu.A.;
     KHRENOV, B.A.

Description of a modernized complex setup for studying exten-
sive air showers. Izv. AN SSSR Ser. fiz. 28 no.12:2087-2092
D '64   (MIRA 18:2)

L 1887-66   EWT(1)/EWT(m)/FCC/T/EWA(h)   IJP(c)   GS/GW
ACCESSION NR: AT5022828   UR/0000/65/000/000/0103/0110

AUTHOR: Vernov, S. N.; Solov'yeva, V. I.; Khrenov, B. A.; Khristiansen, G. B.

TITLE: Primary cosmic radiation in the ultrahigh energy range and extensive
air showers

SOURCE: Vsesoyuznoye soveshchaniye po kosmofizicheskomu napravleniyu issledo-
vaniy kosmicheskikh luchey. 1st, Yakutsk, 1962. Kosmicheskiye luchi i problemy
kosmofiziki (Cosmic rays and problems in cosmophysics); trudy soveschaniya.
Novosibirsk, Redizdat Sib. otd. AN SSSR, 1965, 103-110

TOPIC TAGS: extensive air shower, mu meson, primary cosmic ray, cosmic radiation
energy, astrophysic instrument

ABSTRACT: The device used at the MGU for studying extensive air showers (EAS)
has yielded extensive experimental data pertaining to ultrahigh-energy primary
cosmic radiation. The present report cites cumulative experimental data for
1960-1961. The device consists of 18 points (arranged in a circle of 120 m
radius) at which detectors of charged particle densities and mu-mesons are
located (Fig. 1 of the Enclosure). A very valuable feature of the device is its
ability to record high-energy mu-meson fluxes in an individual shower. The
energy spectrum of primary cosmic radiation obtained is discussed. The
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L 1887-66
ACCESSION NR: AT5022828

experimental data are used to determine the probability that pure electron-
photon showers comprise a fraction α of the total number of recorded showers n:

$$P(\alpha n) \sim \sum_{n_i} \sum_{m=0}^{n_i} \frac{[\exp(-\alpha n_i)](\alpha n_i)^m}{m!} \left(1 - e^{-p_{\mu i}^y}\right)^m,$$

where n_i is the number of EAS with a density of mu-mesons $p_{\mu i}^n$; $p_{\mu i}^y$ is the
density of mu-mesons in pure electron-photon showers with the same number of
particles N as in the observed EAS. Calculation shows that $\alpha < 2 \times 10^{-3}$ with
90% probability. The upper limit for the fraction of primary γ quanta with
energy of $\sim 10^{16}$ ev is from 4×10^{-4} to 10^{-4}. In conclusion, the isotropy of
primary cosmic radiation of the highest energy that can be recorded by the
device is discussed. Orig. art. has: 2 figures and 2 table.s

ASSOCIATION: Nauchno-issledovatel'skiy institut yadernoy fiziki MGU
(Scientific Research Institute of Nuclear Physics, MGU)

SUBMITTED: 29Oct64   ENCL: 01   SUB CODE: AA

NO REF SOV: 006   OTHER: 006

Card 2/3

L 1887-66

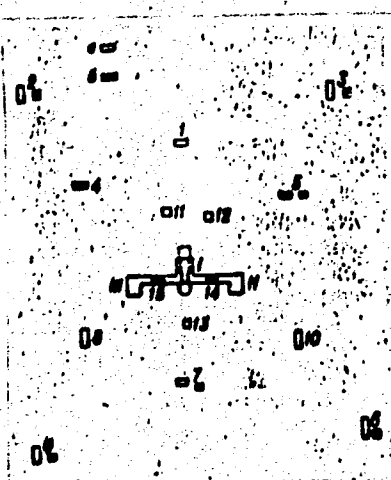ACCESSION NR: AT5022828   ENCLOSURE: 01

Figure 1. Diagram of cosmic ray and air shower recording device,

a - detectors of charged particle density; b - mu-meson detectors
(E $\geqslant$ 6 x 10^8)

Card 3/3

KHRENOV, B.A.

Spatial distribution of muon fluxes in extensive air showers. IAd. fiz. 1 no.3:540-546 Mr '65.   (MIRA 18:5)

1. Institut yadernoy fiziki Moskovskogo gosudarstvennogo universiteta.

L 4528-66   EWT(m)/FCC/T   IJP(c)

ACC NR: AP5024632

SOURCE CODE: UR/0048/65/029/009/1676/1681

AUTHOR: Vernov, S.N.; Khristiansen, G.B.; Abrosimov, A.T.; Atrashkevich, V.B.; Belyayeva, I.F.; Vedeneyev, O.V.; Kulikov, G.V.; Fomin, Yu. A.; Nechin, Yu. A.; Solov'yeva, V.I.; Khrenov, B.A.

ORG: none

TITLE: Investigations of fluctuations in the development of extensive air showers with a fixed total number of charged particles and a fixed total number of muons /Report, All-Union Conference on Cosmic Ray Physics held at Apatity 24-31 August 1964/

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v. 29, no. 9, 1965, 1676-1681

TOPIC TAGS: cosmic ray shower, muon, charged particle, extensive air shower, particle distribution, particle distribution

ABSTRACT: The authors have employed the modernized installation at Moscow State University, described elsewhere (S.N.Vernov et al., Izv. AN SSSR Ser. fiz., 28, 2087, 1964), to investigate the simultaneous distribution of total number N of charged particles, total number M of muons, and age parameter S in extensive air showers. Showers were selected for which the zenith angle of the axis was less than 30°. M was determined from the number of muons recorded by the muon detector and the perpendicular distance of the muon detector from the shower axis with the aid of the known lateral distribution of muons. The relative error in determining M did not exceed 35 %. The

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L 4528–56

ACC NR: AP5024632 ∂

error in determining S was estimated to be 0.02 by processing "artificial" showers of
known age, calculated by Monte Carlo methods. The data presented were derived from
some 300 showers with total numbers of charged particles ranging from 10^5 to 4×10^6.
Histograms are given showing the distribution of showers with respect to N with fixed
M, with respect to M with fixed N, with respect to S with fixed N, and with respect to
S with fixed M, and scatter plots are given for N versus S with fixed M and for M ver-
sus S with fixed N. The correlation coefficient of S with M for fixed N ranged be-
tween 0.62 and 0.72; the correlation coefficient of S with N for fixed M was - 0.67.
Orig. art. has: 10 formulas, 4 figures, and 1 table.

SUB CODE: NP/ SUBM DATE: 00/   ORIG REF: 008/ OTH REF: 001

Card 2/2

L 4529-66   EWT(m)/FCC/T   IJP(c)

ACC NR: AP5024633   SOURCE CODE: UR/0048/65/029/009/1682/1685

AUTHOR: Vernov, S.N.; Khrenov, B.A.; Khristiansen, G.B.

ORG: Scientific Research Institute of Nuclear Physics, Moscow State University im. M.V.Lomonosov (Nauchno-issledovatel'skiy institut yadernoy fiziki Moskovskogo gosudarstvennogo universiteta)

TITLE: Structure of the central region of a muon shower at 40 m.w.e. /Report, All-Union Conference on Cosmic Ray Physics held at Apatity 24-31 August 1964/

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v. 29, no. 9, 1965, 1682-1685

TOPIC TAGS: cosmic ray shower, extensive air shower, muon

ABSTRACT: The authors have employed the complex modernized installation at Moscow State University, described elsewhere (S.N.Vernov et al., Izv. AN SSSR. Ser. fiz., 28, 2087, 1964), to investigate the structure of the central regions of muon showers accompanying extensive air showers. The muon flux at 40 m.w.e. underground was found to be proportional to r^n, where r is the distance from the shower axis and $n = 1/2$ for $7 \text{ m} < r < 15 \text{ m}$ and $r = 1$ for $15 \text{ m} < r < 100 \text{ m}$; it was not possible to obtain the lateral distribution for $r < 7$ m because of the errors in determining r. The ratio of the numbers of counters triggered in the two halves of the muon detector and the probability for triggering neighboring counters were subjected to statistical analysis,

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L 4529-66

ACC NR: AP5024633

and after correction was made for Poisson fluctuations there remained evidence that there exist in the center of the muon shower groups of associated muons with diameters from 2 to 3 m which are capable either of contracting into narrow groups with diamet- ers less than 30 cm or of producing secondary showers. Orig. art. has: 1 formula, 3 figures, and 1 table.

SUB CODE: NP/ SUBM DATE: 00/·   ORIG REF: 005/ OTH REF: 000

Card 2/2

VERNOV, S.N.; KHRISTIANSEN, G.B.; ABROSIMOV, A.T.; ATRASHKEVICH, V.B.;
        BELYAYEVA, I.F.; KULIKOV, G.V.; SOLOV'YEVA, V.I.; FOMIN, Yu.A.;
        KHRENOV, B.A.

Ultrahigh-energy primary cosmic radiation according to data on
extensive air showers. Izv. AN SSSR.Ser.Fiz. 29 no.10:1876-1880
0 '65.   (MIRA 18:10)

1. Nauchno-issledovatel'skiy institut yadernoy fiziki Moskovskogo
gosudarstvennogo universiteta im. M.V.Lomonosova.

L 25772-66   EWT(m)/FCC/T   IJP(c)

ACC NR: AP6016380   SOURCE CODE: UR/0048/65/029/010/1876/1880

AUTHOR: Vernov, S. N.; Khristiansen, G. B.; Abrosimov, A. T.; Atrashkevich, V. B.;
Belyayeva, I. F.; Kulikov, G. V.; Solov'yeva, V. I.; Fomin, Yu. A.; Khrenov, B. A.

ORG: Scientific Research Institute of Nuclear Physics, Moscow State University im.
M. V. Lomonosov (Nauchno-issledovatel'skiy institut yadernoy fiziki Moskovskogo
gosudarstvennogo universiteta)

TITLE: Primary superhigh-energy cosmic radiation according to data on extensive
atmospheric showers

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v. 29, no. 10, 1965, 1876-1880

TOPIC TAGS: cosmic radiation, muon

ABSTRACT: Of interest in the investigation of the primary energy
spectrum of cosmic rays and their composition is the knowledge of
the spectrum of extensive atmospheric showers (e.a.s.) with respect
to the total number N_μ of high energy muons ($E_\mu \geqslant 10^{10}$ eV) and
the distribution of e.a.s. over the total number of the particles
N_e for a given N_μ.   In this connection the authors analyze the
primary energy spectrum of cosmic rays on the basis of experimental
data obtained with a special device for investigating e.a.s. recor-
ded with a probability of $W \geqslant 0.95$. This device makes it possible
to determine the total number of charged particles in an e.a.s.

Card 1/2

L 25772-66

ACC NR: AP6016380   0

at the observation level. An averaged function ρ_μ(R) is plotted
to determine the spatial distribution N_μ of the muons, and, thus,
the total number of these muons is determined. The distribution
of N_e for a given N_μ is evaluated on the basis of data on an e.a.s.
with N_μ = $(1-2)\cdot 10^4$. The experimental findings are found to be
in satisfactory agreement with theory. Thus, on the basis of the
complex whole of the experimental findings, it may be concluded
that the composition of primary cosmic rays in the superhigh-
energy region apparently does not significantly differ from the
composition in the low-energy region, and the γ-index of the pri-
mary energy spectrum is variable rather than constant. Orig. art. has:
5 figures. [JPRS]

SUB CODE: 20, 04 / SUBM DATE: none / ORIG REF: 009 / OTH REF: 002

Card 2/2 r C

ACC NR: AP7007082

SOURCE CODE: UR/0048/66/030/010/1694/1696

AUTHOR: Vernov, S. N.; Khristiansen, G. B.; Nechin, Yu. A.; Stoyanova, D. A.; Khrenov, B. A.

ORG: none

TITLE: Groups of particles at a depth of 40 meters entering into the composition of broad atmospheric showers /Paper presented at the All-Union Conference on Cosmic Radiation Physics, Moscow, 15-20 Nov 1965/

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v. 30, no. 10, 1966, 1694-1696

TOPIC TAGS: muon, physics conference

SUB CODE: 20,04

ABSTRACT: A study of the flux of particles at a depth of 40 m underground was made using the Moscow State University installation for the investigation of broad atmospheric showers. The purpose of the work described was determination of the shower-forming capacity of particles belonging to non-Poisson groups observed in the vicinity of the axis of showers. By assuming that the particles present in the groups observed were muons and using the experimental data obtained, the authors estimated that the average energy of muons in these shower-forming groups was $10^{12} < E_\mu < 10^{13}$ ev. The determination of the shower-forming capacity is of value in estimating the full amount of energy carried away by a muon group in a broad atmospheric shower. It was shown that the muons in a group have an energy of $\sim 10^3$ Bev $< E_\mu < 10^4$ Bev. This indicates that a muon group cannot carry away more than 10% of the energy of a primary particle, and therefore cannot be responsible for the escape of a signi-

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ACC NR: AP7007082

ficant amount of energy in the atmosphere. Presence of concentrated groups of high-energy muons ($E \gtrsim 10^{12}$ ev) at a depth of 40m cannot be explained from the standpoint of theoretical concepts concerning the development of broad atmospheric showers that have hitherto been advanced. Orig. art. has: 4 figures.

/JPRS: 39,658/

Card 2/2

(6)

ACC NR: AP7007081   SOURCE CODE: UR/0048/66/030/010/1685/1689

AUTHOR: Vernov, S. N.; Khristiansen, G. B.; Abrosimov, A. T.; Atrashkevich,
V. B.; Belyayeva, I. F.; Vedeneyev, O. V.; Kulikov, G. B.; Nechin, Yu. A.;
Solov'yeva, V. I.; Fomin, Yu. A.; Khrenov, B. A.

ORG: none

TITLE: Phenomenological characteristics of broad atmospheric showers with
a fixed number of μ-mesons and electrons /Paper presented at the All-Union
Conference on Cosmic Radiation Physics, Moscow, 15-20 Nov 1965/

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v. 30, no. 10, 1966,
1685-1689

TOPIC TAGS: mu meson, cosmic radiation

SUB CODE: 20

ABSTRACT: In an earlier work by Vernov et al (Izvestiya Akademij Nauk SSSR,
Seriya Fizicheskaya, 29, 1676, 1965), results obtained in a study at an instal-
lation of Moscow State University on broad atmospheric showers with zenith
angles of 0-30° were reported. These results included the distribution of showers
with a fixed number of electrons N_e with respect to the number of high-energy
mesons N_μ and the age parameter S, distribution of showers with a fixed N_μ with
respect to N_e and S, and the coefficients of the correlation between S and the
fluxes of electrons and μ-mesons. In the work reported in this instance, the
same relations were determined for broad atmospheric showers with zenith angles
of 30-45°. The fluctuations of N_μ, S, and N_e, observed for an effective atmo-
spheric depth of 1240 g/cm², were the same as those for vertical showers esta-
blished in the earlier work. To determine the differences due to an increase in

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ACC NR: AP7007081

the effective atmospheric depth of 200 g/cm^2, calculations must be carried out with greater statistical precision. When results of the theoretical calculations on characteristics of broad atmospheric showers at 1240 g/cm become available, the experimental data reported will be useful for the determination of the composition of primary cosmic radiation in the superhigh-energy range. [JPRS, 39,638]

Orig. art. has: 5 figures, 2 formulas and 1 table.

Card 2/2

KHRENOV, B. M

Korolenok, K. Kh. and Khrenov, B. M. "An analysis of two cases of pathological intoxi-
cation," In the collection: Voprosy klinich, psikhiatrii, (Irkutsk),
1948, p. 151-64.

SO: U-3736, 21 May 53, (Letopis 'Zhurnal 'nykh Statey, No. 18, 1949).

KHRENOV, B. M.

Korolenok, K. Kh. and Khrenov, B. M. "On the vascular-psychiatric view of pathological
intoxication," In the collection: Voprosy klinch. psikhiatrii,
(Irkutsk), 1948, p. 203-12.

SO: U-3736, 21 May 53, (Letopis 'Zhurnal 'nykh Statey, No. 18, 1949).

VORONIN, S.Ye.; KHRENOV, B.P.

Loader-trucks for the handling of liquid metal. Lit.proizv.
no.11:41 N '61.   (MIRA 14:10)
          (Foundries—Equipment and supplies)

KHRENOV, B. YA.

Dissertation defended for the degree of Candidate of Physicomathematical
Sciences at the Physics imeni P. N. Lebedev in 1962:

"Study of Streams of High Energy mu-mesons in the Composition of Extended
Atmospheric Showers."

Vest. Akad. Nauk SSSR.   No. 4, Moscow, 1963, pages 119-145

KHRENOV, D.

Labor cooperation. Mast. ugl. 8 no.8:13-14 Ag '59.
(MIRA 12:12)

1. Predsedatel' Luganskogo obkoma profsoyuza rabochikh ugol'noy promyshlennosti.
(Lugansk Province--Coal miners)

KHRENOV, D.

Photographic laboratory in a room. Sov. foto 18 no.4:33-36 Ap '58.

(MIRA 11:6)

(Photography--Studios and dark rooms)

SOROCHKIN, Yu.N.; KHRENOV, E.I.; IVASHKEVICH, V.

The "Zaporozhets ZAZ-965A" automobile with a very small cylinder capacity. Biul.tekh.-ekon.inform.Gos.nauch.-issl.inst.nauch.i tekh.inform. 16 no.7:67-68 '63.   (MIRA 16:8)
                              (Automobiles)

KHRENOV, G. (g.Kirov)

Electric heaters mounted on the GAZ-51 chassis used for warming
up automobile engines. Pozh.delo 4 no.8:19-20 Ag '58.   (MIRA 11:9)
(Automobiles--Cold weather operation)

KHRENOV, G.

Volunteer councils for the improvement of public areas and
services. Zhil.-kom. khoz. 11 no.12:12   D '61.   (MIRA 16:11)

1. Predsedatel' obshchestvennogo soveta po blagoustroystvu gorodov
i rabochikh poselkov pri Moskovskom oblastnom otdele kommunal'nogo
khozyaystva.

KHRENOV, G. S.

C. A

20

Thermo-insulating sheets. G. S. Khrenov. U.S.S.R. 60,060, Dec. 31, 1937. The sheets are made of gypsum and mineralized org. fibrous filler, e.g., sawdust. The sawdust is mineralized by mixing it with quicklime. The gypsum is added as a soln. having a temp. of 60°. The ratio of water and gypsum is so calcd. that the slaking of the quicklime be complete.   M. Hoseh